

The Staggered Nodal Finite Element Method (SNFEM) discretization for non-hydrostatic atmospheric modeling

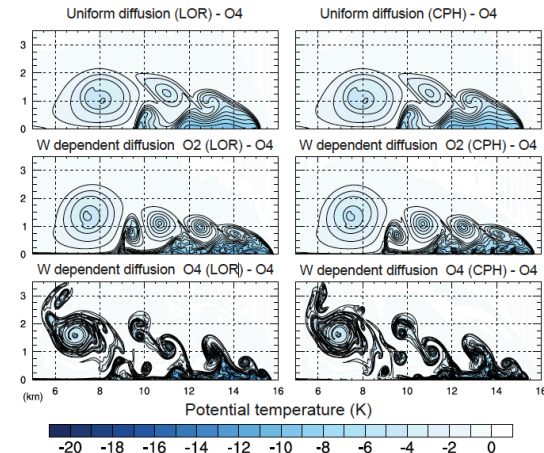
Objective

To present the formulation of a new finite element vertical discretization of the non-hydrostatic fluid equations with grid staggering. Also to provide a suite of validation test results showing the performance of the numerical model.

Research results

- Tested the SNFEM in several cases ranging in scale from planetary to convective eddy (10 m). Performance is shown to be consistent over these scales for both linear and nonlinear phenomena. Structural effects of variable order of accuracy are also demonstrated.

Reference: Guerra, J. E. and Ullrich, P. A.: A high-order staggered finite-element vertical discretization for non-hydrostatic atmospheric models, *Geosci. Model Dev.*, 9, 2007-2029, <https://doi.org/10.5194/gmd-9-2007-2016>, 2016.



Impact

- We demonstrate an improved staggered discretization with superior dispersion properties and arbitrary accuracy.
- The model is fast and flexible allowing rapid testing of different vertical discretizations in a parallel framework. Time integration schemes can also be tested in order to perform sensitivity and optimization studies over variations in the combined discretization.